

**WHAT IS CLAIMED IS:**

1. An article comprising:  
a base string;  
5 a first row of substantially parallel, elongated members, each elongated member of the first row having a proximal end connected to one side of the base string; and  
a second row of substantially parallel, elongated  
10 members, each elongated member of the second row having a proximal end connected to another side of the base string.
2. An article according to claim 1, wherein the first and second rows of substantially parallel, elongated  
15 members extend outwardly from the base string at an angle.
3. An article according to claim 2, wherein the angle is substantially ninety degrees.
4. An article according to claim 1, wherein the base  
20 string and the elongated members of both rows are made of a polymeric material.
5. An article according to claim 4, wherein the polymeric material is selected from the group consisting of nylon resins, acetal resins, and  
25 polyester resins.
6. An article according to claim 1, wherein the base string has a cross-sectional shape selected from the

group consisting of oval, round, ellipsoid, square, square with mid-point ribs, and rectangular.

7. An article according to claim 1, wherein the base string is made of a first material and the elongated members of both rows are made of a second, different material.

8. An article according to claim 1, wherein the elongated members are brush bristles made of a polymeric monofilament material selected from the group consisting of nylon resins, acetal resins, and polyester resins.

9. An article according to claim 1, wherein the elongated members are carpet tufts made of a polymeric, polyfilament material.

10. An article according to claim 1, wherein the first and second rows of elongated members are made of polymeric monofilament material, and wherein the outer surfaces of the elongated members contact outer surfaces of the base string and form a flow zone which connects the elongated members to the base string.

11. An apparatus for making elongated articles comprising:

a first station including a first mandrel, a first wrapping mechanism for wrapping a first filament around the first mandrel to thereby form a plurality of first wraps, a first feeding mechanism for feeding at least

one base string into contact with the first wraps, a first bonding mechanism for bonding the at least one base string to the first wraps at their points of contact with the base string, and a first cutting  
5 mechanism for cutting the first wraps in proximity to the at least one base string to thereby form a subassembly having a base string and a first row of elongated members;

a second station including a second mandrel, a  
10 second wrapping mechanism for wrapping a second filament around the second mandrel to thereby form a plurality of second wraps, a second feeding mechanism for feeding the base string of the subassembly into contact with the second wraps, a second bonding  
15 mechanism for bonding the base string of the subassembly to the second wraps at their points of contact with the base string, and a second cutting mechanism for cutting the second wraps in proximity to the base string of the subassembly to thereby form a  
20 modified subassembly having a base string, a first row of elongated members formed by the first wraps and a second row of elongated members formed by the second wraps.

12. An apparatus according to claim 11, wherein the  
25 first and second mandrels include a polyhedron-shaped elongated bar having means for transporting the first wraps and second wraps along their respective lengths.

13. An apparatus according to claim 11, wherein each  
30 of the first and second mandrels includes at least one anvil to ensure transformation of ultrasonic energy

into frictional heating of the first and second wraps with the respective base strings at a bonding zone.

14. An apparatus according to claim 13, wherein each of the at least one anvils is detachably connected to  
5 an insert carried by each of the first and second mandrels.

15. An apparatus according to claim 14, wherein each insert is detachably connected to each of the first and second mandrels.

10 16. An apparatus according to claim 13, wherein each anvil has a wrap-engaging surface that is sloped at between 0 and 5 degrees.

17. An apparatus according to claim 11, wherein each of the first and second wrapping mechanisms includes a  
15 wrapper for wrapping the first and second filaments respectively around the first and second mandrels.

18. An apparatus according to claim 11, wherein the first bonding mechanism includes a plurality of ultrasonic bonders, corresponding in number and  
20 location to the number and location of base strings fed into contact with the first wraps.

19. An apparatus according to claim 18, wherein each ultrasonic bonder includes an ultrasonic horn which engages each base string.

20. An apparatus according to claim 11, wherein the first feeding mechanism includes means for feeding a plurality of base strings respectively to each corner of the first mandrel and to a predetermined point  
5 between two adjacent corners of the first mandrel.

21. An apparatus according to claim 11, wherein the first cutting mechanism includes means for cutting the first wraps in proximity to each base string.

22. An apparatus according to claim 11, wherein the  
10 first feeding mechanism includes means for feeding a plurality of base strings respectively to each corner of the first mandrel and to each mid-point between each corner of the first mandrel.

23. An apparatus according to claim 21, wherein the  
15 means for cutting the first wraps includes a pair of slitters for each adjacent pair of mid-point and corner base strings.

24. An apparatus according to claim 11, wherein the second feeding mechanism includes means for feeding a  
20 plurality of subassemblies respectively to each corner of the second mandrel and to a predetermined point between each corner of the second mandrel.

25. An apparatus according to claim 11, wherein the second bonding mechanism includes a plurality of  
25 ultrasonic bonders, corresponding in number and location to the number and location of subassemblies fed into intact with the second wraps.

26. An apparatus according to claim 11, wherein the second cutting mechanism includes means for cutting the second wraps in proximity to each of the base strings of each subassembly.
- 5 27. An apparatus according to claim 11, wherein a bonding area is defined at a location where the first and second elongated members are bonded to the base string, and the apparatus further comprises means for conditioning the bonding area.
- 10 28. An apparatus according to claim 27, wherein the conditioning means includes a conditioning wheel, means for guiding the modified subassembly to the conditioning wheel, and means for heating a region around the base string of the modified subassembly on  
15 the conditioning wheel.
29. An apparatus according to claim 28, further comprising means for cooling the conditioning wheel at a point spaced from the heating means.
30. An apparatus according to claim 28, wherein the  
20 conditioning wheel includes and circumferential groove for receiving the elongated members and the base string of the modified subassembly.
31. An apparatus according to claim 29, wherein the heating means comprises a hot air blower disposed  
25 adjacent to the conditioning wheel, and the cooling means includes a tank of cooling fluid into which the conditioning wheel extends.
32. An apparatus according to claim 28, wherein the guiding means includes at least one guide roller.

33. An apparatus according to claim 28, wherein the guiding means includes a guide roller having a central hub for engaging the base string of the modified subassembly, and a guide sleeve extending between the  
5 guide roller and the conditioning wheel.

34. An apparatus according to claim 33, wherein the conditioning wheel includes a circumferential groove, and the guide sleeve extends into the circumferential groove.

10 35. A method of making articles comprising:  
providing a base string;  
attaching a first row of substantially parallel, elongated members to one side of the base string; and  
attaching a second row of substantially parallel,  
15 elongated members to another side of the base string.

36. A method according to claim 35, wherein attaching the first row includes attaching each elongated member of the first row to extend substantially normal to the base string, and attaching the second row includes  
20 attaching each elongated member of the second row to extend substantially normal to the base string.

37. A method according to claim 35, wherein attaching the first row includes providing a first station which includes a first mandrel, wrapping a first filament  
25 around the first mandrel to thereby form a plurality of first wraps, feeding at least one base string into contact with the first wraps, bonding the at least one base string to the first wraps at their points of

contact with the base string, and cutting the first wraps in proximity to the at least one base string to thereby form a subassembly having a base string and a first row of elongated members.

- 5 38. A method according to claim 35, wherein attaching the second row includes providing a second station which includes a second mandrel, wrapping a second filament around the second mandrel to thereby form a plurality of second wraps, feeding the base string of
- 10 the subassembly into contact with the second wraps, bonding the base string of the subassembly to the second wraps at their points of contact with the base string, and cutting the second wraps in proximity to the base string of the subassembly to thereby form a
- 15 modified subassembly having a base string, a first row of elongated members formed by the first wraps and a second row of elongated members formed by the second wraps.

39. A method according to claim 35, wherein the first
- 20 wraps are different from the second wraps in at least one property selected from the group consisting of size, shape, composition, physical properties, and color.

40. A method according to claim 35, wherein at least
- 25 one of the base string and the filament wraps is made of a polymer material selected from the group consisting of nylon, polyester, and acetal.



41. A method according to claim 35, wherein at least one of the base string and the elongated members are made of a polymeric monofilament material.

42. A method according to claim 35, wherein at least one of the base string and the elongated members are made of a polymeric multifilament material.

43. A method of forming bristle subassemblies comprising:

wrapping a first filament around a first mandrel  
10 to thereby form a plurality of first wraps;  
feeding at least one base string into contact with the plurality of first wraps;  
bonding the at least one base string to the plurality of first wraps;  
15 cutting the plurality of first wraps to form at least one bristle subassembly;  
wrapping a second filament around a second mandrel to thereby form a plurality of second wraps;  
feeding the at least one bristle subassembly into  
20 contact with the plurality of second wraps with the base string contacting the second wraps;  
bonding the base string of the bristle subassembly to the plurality of second wraps; and  
cutting the plurality of second wraps to form at  
25 least one modified bristle subassembly having two rows of bristles.

44. A method according to claim 43, wherein the step of feeding at least one base string includes feeding a

plurality of base strings to the plurality of first wraps, including a base string for each corner of the first mandrel and for a predetermined point between each corner, and the bonding step includes bonding the  
5 plurality of first wraps to the plurality of base strings.

45. A method according to claim 43, wherein cutting the plurality of first wraps includes cutting the first  
10 wraps at one side of the plurality of base strings to form a plurality of bristle subassemblies having one row of bristles.

46. A method according to claim 43, wherein feeding  
15 the at least one bristle subassembly includes feeding the plurality of bristle subassemblies to the plurality of second wraps, and bonding the plurality of second wraps includes bonding the base strings of the plurality of bristle subassemblies to the plurality of  
20 second wraps, and cutting the plurality of second wraps includes cutting the second wraps at one side of each base string of each of the plurality of bristle subassemblies to thereby form a plurality of modified bristle subassemblies, each having two rows of  
25 bristles.

47. A method according to claim 43, wherein cutting includes cutting with means selected from the group consisting of rotating cutter blades, reciprocating  
30 blades, and lasers.

48. A method according to claim 47, further comprising applying a cooling fluid to the cutter blades to improve blade performance and extend useful life.

- 5 49. A method according to claim 43, wherein bonding comprises applying energy to the first and second wraps, wherein the energy is selected from the group consisting of ultrasonic energy, laser energy, and radiant heat energy.

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50. A product made by the method of Claim 43.

51. An apparatus for conditioning a subassembly having a base string and at least one row of elongated members  
15 connected to the base string, comprising:

a conditioning wheel having a groove formed inwardly along a peripheral surface of the conditioning wheel for receiving the subassembly with the base string on an upper portion of the groove and the  
20 elongated members extending into a lower portion of the groove;

a heating source disposed adjacent the conditioning wheel and in fluid communication with the base string; and

- 25 a cooling source disposed in fluid communication with the conditioning wheel at a point spaced from the heating source.

52. An apparatus according to claim 51, wherein the  
30 heating source is a blower having a heating element.

53. An apparatus according to claim 51, wherein the cooling source is a tank containing a cooling fluid, wherein the conditioning wheel extends at least partially into the cooling tank.

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54. An apparatus according to claim 53, further comprising means for removing heat from the cooling fluid.

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55. An apparatus according to claim 51, further comprising a guide sleeve for guiding the elongated members into the groove.

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56. An apparatus according to claim 55, further comprising a guide roller, and wherein the guide sleeve extends between the conditioning wheel and the guide roller.

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57. An apparatus comprising:  
a body; and

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at least one subassembly connected to the body, the subassembly comprising a base string, a first row of substantially parallel, elongated members, each elongated member of the first row having a proximal end connected to the one side of the base string, and a second row of substantially parallel, elongated members, each elongated member of the second row having a proximal end connected to a opposite side of the base string.

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58. An apparatus according to claim 57, wherein the body is a brush and the first and second rows of elongated members are bristles.

5 59. An apparatus according to claim 57, wherein the first and second rows of elongated members are bristles made of polymeric monofilament material, and the base string is made of polymeric monofilament material.

10 60. An apparatus according to claim 58, wherein the polymeric monofilament is NYLON.

61. An article comprising:

a first base string;

15 a first row of substantially parallel, elongated members, each elongated member of the first row having a proximal end connected to the one side of the first base string;

a second base string;

20 a second row of substantially parallel, elongated members, each elongated member of the second row having a proximal end connected to a opposite side of the second base string,

25 the first row of elongated members being connected to the second row of elongated members and being disposed between the first and second base strings.

62. An article according to claim 61, wherein the first and second rows of substantially parallel,  
30 elongated members extend outwardly from the first and second base strings at an angle.

63. An article according to claim 62, wherein the angle is substantially ninety degrees.

64. An article according to claim 61, wherein the  
5 first and second base strings and the elongated members of both rows are made of a polymeric material.

65. An article according to claim 64, wherein the polymeric material is selected from the group  
10 consisting of nylon resins, acetal resins, and polyester resins.

66. An article according to claim 61, wherein the first and second base strings have a cross-sectional  
15 shape selected from the group consisting of oval, round, ellipsoid, square, square with mid-point ribs, and rectangular.

67. An article according to claim 61, wherein the  
20 first and second base strings are made of a first material and the elongated members of both rows are made of a second, different material.

68. An article according to claim 61, wherein the  
25 elongated members are brush bristles made of a polymeric monofilament material selected from the group consisting of nylon resins, acetal resins, and polyester resins.

69. An article according to claim 61, wherein the  
30 first and second base strings have a cross-sectional shape selected from the group consisting of oval,

round, ellipsoid, square, square with mid-point ribs,  
and rectangular.

70. An article according to claim 61, wherein the  
5 elongated members of the first row differ from the  
elongated members of the second row in a property  
selected from the group consisting of size, shape,  
color, and filament structure.

10 71. An article according to claim 61, wherein the  
filament structure is selected from the group  
consisting of monofilament and polyfilament.

72. An article according to claim 61, wherein the  
15 elongated members are carpet tufts made of a polymeric,  
polyfilament material.

73. An article according to claim 61, further  
comprising a brush body having a handle portion and a  
20 head portion, wherein the first and second base strings  
are connected to the head portion.

74. A method for conditioning a subassembly having a  
base string and at least one row of elongated members  
25 connected to the base string, comprising:  
positioning proximal ends of the elongated members  
in juxtaposition to a source of heat; and heating the  
proximal ends of the elongated members.

30 75. A method according to claim 74, wherein the  
positioning and heating comprises providing a  
conditioning wheel having a groove formed inwardly

along a peripheral surface of the conditioning wheel for receiving the subassembly with the base string on an upper portion of the groove and the elongated members extending into a lower portion of the groove, providing a heating source disposed adjacent the conditioning wheel and in fluid communication with the base string, and placing a cooling source in fluid communication with the conditioning wheel at a point spaced from the heating source.

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76. An article comprising:

a base string;

a first row of substantially parallel, elongated members, each elongated member of the first row having a proximal end connected to the base string; and

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a second row of substantially parallel, elongated members, each elongated member of the second row having a proximal end connected to the base string,

wherein the elongated members of the first row differ from the elongated members of the second row in at least one quality selected from the group consisting of size, shape, color, material composition, and filament structure.

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77. An article according to claim 76, wherein the first row of elongated members are connected to one side of the base string and the second row of bristles are connected to another side of the base string.

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78. An article according to claim 75, wherein the filament structure of the first row of elongated members is monofilament, and the filament structure of the second row of elongated members is polyfilament.

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